C 37078 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
JUNE 2004

EE. 2K. 405/PTEE. 2K. 303—ELECTRICAL MACHINES—I

(New Scheme)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*
Assume suitable data that are not given.

I. (a) Distinguish between single-layer windings and double layer windings.

(b) Bring out the difference between lap and wave windings used for the d.c. machine armature with suitable diagrams. What are the main factors for the choice between lap and wave windings ?

(c) A 4-pole d.c. generator generates 500 V on open circuit at 600 r.p.m. If the armature is wave wound and has 144 slots with 2 coil sides per slot and 3 turns per coil, calculate the flux per pole.

(d) Describe with sketches the process of commutation in a d.c. generator.

(e) Explain the essential requirements for the operations of two shunt generators in parallel and how they share the load.

(f) A starter is required for a 220 V shunt motor. The maximum allowable current is 60 A and the minimum current is 30 A. Find the number of sections of the starter resistance required and the resistance of each section, the armature resistance of the motor is 0.4 ohm.

(g) Explain clearly the phenomenon of in-rush current in a transformer.

(h) Write short notes on the tap-changing transformers.

(8 × 5 = 40 marks)

II. (a) A 3-phase, 10-pole machine has 72 armature slots. Construct the winding table for fractional slot winding. Draw the winding diagram with a coil-span of seven slots.

(15 marks)

Or

(b) (i) Derive an expression for the e.m.f. induced in a 3-phase alternator. (7 marks)

(ii) A 3-phase, 50 Hz, star-connected alternator with 2-layer winding is running at 600 r.p.m. It has 12 turns/coil, 4 slots/pole/phase and a coil-pitch of 10 slots. If the flux/pole is 0.035 Wb sinusoidally distributed, find the phase and line e.m.f.'s induced. Assume that the total turns/phase are series connected.

(8 marks)

III. (a) (i) Explain the principle of operation of d.c. motor. (8 marks)

(ii) In a 110 V d.c. compound generator, the resistance of the armature, shunt and series Windings are 0.06, 25 and 0.05 Ω respectively. The load consists of 200 lamps each rated at 55 W, 110 V. Find the total e.m.f. and armature current, when the machine is connected as long shunt.

(7 marks)

Or

Turn over

(b) (i) Explain the meaning of armature reaction as applied to a d.c. generator and describe how the armature reaction affects the working of d.c. generator.

(8 marks)

(ii) A 30 hp. 500 V, 4-pole, wave wound d.c. shunt motor has 840 armature conductors and 105 commutator segments. Its full-load efficiency is 85 % and the shunt field resistance is 250 Ω. If brushes are shifted backwards through 1.5 segments from the GNA, find the demagnetizing and distorting ampere turns per pole at full-load.

(7 marks)

IV. (a) (i) Draw and explain the OCC of a D.C. Shunt generator. (7 marks)

(ii) A shunt generator supplies 195 A at 220 V. Armature resistance is 0.02 Ω and shunt field resistance is 44 Ω. If the iron and friction losses amount to 1600 W, find (a) e.m.f. generated, (b) total copper loss in the machine and (c) efficiency.

(8 marks)

Or

(b) Hopkinson's test on two machines gave the following results for full load : line voltage = 230 V, line current excluding field current = 50 A, motor armature current = 380 A, field currents are 5 and 4.2 A, calculate the efficiency of each machine. The armature resistance of each machine = 0.02 Ω. Draw the neat circuit arrangement for the test.

(15 marks)

V. (a) (i) Explain open-circuit test and short-circuit test of a single-phase transformer giving circuit diagram for each test.

(7 marks)

(ii) A 50 kVA, 2,200/110 V transformer when tested gave the following results :—

OC test, measurements on the LV side : 400 W, 10 A, 110 V

SC test, measurements on the HV side : 808 W, 20.5 A, 90 V

Compute all the parameters of the equivalent circuit referred to the HV and LV sides of the transformer.

(8 marks)

Or

(b) (i) Explain the principle of working of an auto-transformer. Also derive an expression for the saving in copper by using an auto-transformer instead of a two-winding transformer for the same kVA rating.

(8 marks)

(ii) A 400/100 V, 10 kVA, 2-winding transformer is to be employed as an auto-transformer to supply a 400 V circuit from a 500 V source. When tested as a 2-winding transformer at rated load, 0.85 p.f. lagging, its efficiency is 0.97, (i) determine its kVA rating as an auto-transformer and (ii) find its efficiency as an auto-transformer.

(7 marks)

[4 × 15 = 60 marks]